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gested by Mr. Jerome Alexander in SCIENCE, July 22, page 74, to the effect that the evaporating surface is increased by the comminution of the soil, with the resulting increase of evaporation of the soil water. This in turn results in a greater upward flow of the soil water from below, bringing with it a greater store of plant food than would normally be transported from the depths of the soil. This induced upward movement of the soil water is thought by the author of the note in question to account also for "the curious fact well known to farmers, that in dry weather, cultivation will to a considerable extent furnish moisture to the growing crops."

The value of cultivation (aside from the killing of weeds) is unquestionably the result of a number of diverse factors, the bare enumeration of which would transcend the limits of the space available in SCIENCE. So far, however, as the movements of the soil water are influenced by the comminution of the surface concerned, there are two chief results which prove of benefit to the growing crops.

By evaporation at the surface, the minerals held in solution are left behind at a locality inaccessible to the feeding roots, which can not long exist at the surface of the land. Cultivation of the surface moves this zone of concentration to the subsurface, and here the roots are able to take advantage of the greater concentrated solution of plant foods.

The well-known fact that tilth apparently increases the amount of moisture in the land is accounted for by the *exact reversal of the hypothesis suggested* by Mr. Alexander, the fact being that the comminution of the upper surface of the soil, instead of increasing the evaporation of the soil water, more or less perfectly *stops evaporation, and thus conserves the store of soil water.*

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BACTERIA IN THE AMERICAN PERMIAN

THE presence of bacteria in the closing period of the American Paleozoic has been suggested by the condition of the fractured

reptilian spine, recalling an osteomyelitis, already noted.¹ At the time this first notice was written microscopic sections of the fossil spine had not been studied. Since then, I have received four transverse sections through the spine, showing in detail the nature of the sinuses which caused the tumefaction. Careful search through the sections has failed to reveal any sequestrum, such as is commonly found in modern chronic osteomyelitis, nor were bacteria found in the margins of the calcite filled sinuses. The presence of pathogenic bacteria in such a situation would be rather rare in a fossil state, since the nature of fossilization would prevent their preservation. It is doubtful too whether we could prove the pathogenicity of such bacteria save by their location.

Bacteria of the *Micrococcus* type, so common in the fossil vertebrate material studied by Renault from the Autun of France, are however abundantly preserved in the distorted osseous lacunæ. They are similar in all respects to those occurring in the fossil bone of fishes previously described² from the Devonian of America and Scotland. The bacteria, often seen isolated in the terminal bulb of the canaliculus-like burrows, which radiate out from the body of the lacuna, are no doubt those of decay and had nothing to do with the infection producing the osteomyelitis. There seems no doubt that bacteria of this type may be found in any fossil vertebrate material of the type which has been embedded in moist ground long enough to undergo a slight amount of decay, prior to fossilization. The only reason they have been seen so seldom in fossil vertebrate material is simply because no one has looked for them. They are there beyond any question.

The bodies which have been interpreted as bacteria, when seen isolated at a magnification of 1240 diameters, measuring from 1 to 2.5 microns, appear as semicrystalline, rounded, brownish bodies resembling minute specks of amber. The question as to whether they

¹ SCIENCE, N. S., Vol. LIII., No. 1371, p. 333, Apr. 8, 1921.

² SCIENCE, N. S., Vol. LI., No. 1305, p. 14, 1920.

are really bacteria has been satisfactorily discussed by the researches of Bernard Renault who has placed the subject of bacteriology of fossil vertebrate remains on a safe footing. Those seen in the present sections often group themselves in pairs recalling the modern *Diplococci*. I have never seen chains of these forms in vertebrate material.

The other question as to how such minute bits of protoplasm are capable of preservation over many millions of years is one of those unsolved puzzles of paleontology which we may place with that of the fossilization of the ganoid fish brains from Kansas.

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QUOTATIONS

SCIENTIFIC PAPERS

ALTHOUGH the scientific societies made a valiant effort to preserve continuity through the war, the session now closed is the first that has been nearly normal for several years. Most of the younger men were engaged on work that does not qualify for membership of learned societies, and the scientific investigations of the others, young or old, were often advisedly kept secret. Now that science has resumed its old range and almost its old output the precise utility of the weekly and fortnightly meetings of the societies, under discussion before the war, is again being considered. Clearly they have a social value, increased by the almost universal change from the evening to the late afternoon, and by the more abundant presence of ladies, as members or as guests. But what of their specific function as an aid to the advancement of knowledge? It is to be confessed that for the most part this seems slight. Distinguished investigators are not always clear expositors by word of mouth. In many cases the programme is so long that many items, and these often the more interesting, have to be "taken as read." The actual communications made are often such that it is to be doubted if more than one out of ten of the audience has the slightest idea what it is all about. Sir James

Dewar, speaking at the closing meeting of the Royal Institution, possibly partly in jest, ventured the opinion that it was good for people to listen to the most recent results of science, even if they failed to understand them. This is an opinion in which we can not concur, holding, on the contrary, that if there is a state worse than ignorance it is that of the vain worshippers of scientific shibboleths. If the purpose of a meeting is to convey instruction, the exposition should be as simple and clear as that to which Sir James Dewar himself has accustomed his audiences at Albemarle-street.

But the original purpose of the meetings of the scientific societies was to discuss new results rather than to educate. In earlier days, when the range of knowledge was narrower, almost any man of science was capable of emitting a useful impromptu opinion on almost any branch of science. An approach to such a communion between lecturer and audience may still be possible in some of the smaller and more highly specialized societies. In other bodies a useful attempt is sometimes made to reach it, by grouping the papers for a meeting, or by setting a topic for discussion. But even such arrangements frequently fail of their object, because those with most right to be heard are least anxious to criticize or to approve what they have heard for the first time, whilst those who have least claim to serious attention are most ready to hazard opinions. It would be interesting, were some society to experiment with a method frequently suggested, but, so far as we know, not yet actually adopted. It is the custom for the communications made at a meeting to be printed and published subsequently, after due examination by a referee. It is worth noting that strict precautions are taken to prevent substantial alteration or correction of a manuscript, even if the discussion had shown that these would be an advantage. There is therefore no gain by the delay, and much detriment to the value and interest of the meeting. If, on the other hand a paper were published in full, and distributed in the usual way at a due interval before the meeting at